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Please find below and/or attached an Office communication concerning this application or proceeding.

The time period for reply, if any, is set in the attached communication.

Office Action Summary

Application No.

10/597,976

Applicant(s)

REDERT ET AL.

Examiner

Carlos Perromat

Art Unit

2628

Period for Reply -- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) OR THIRTY (30) DAYS, WHICHEVER IS LONGER, FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

- 1) ☒ Responsive to communication(s) filed on 23 November 2009.
- 2a) ☒ This action is **FINAL**. 2b) ☐ This action is non-final.
- 3) ☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

- 4) ☒ Claim(s) 1-17 is/are pending in the application.
- 4a) Of the above claim(s) _____ is/are withdrawn from consideration.
- 5) ☐ Claim(s) _____ is/are allowed.
- 6) ☒ Claim(s) 1-17 is/are rejected.
- 7) ☐ Claim(s) _____ is/are objected to.
- 8) ☐ Claim(s) _____ are subject to restriction and/or election requirement.

Application Papers

- 9) ☐ The specification is objected to by the Examiner.
- 10) ☐ The drawing(s) filed on _____ is/are: a) ☐ accepted or b) ☐ objected to by the Examiner.
- Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).
- Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).
- 11) ☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

Priority under 35 U.S.C. § 119

- 12) ☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).
- a) ☐ All b) ☐ Some * c) ☐ None of:
1. ☐ Certified copies of the priority documents have been received.
 2. ☐ Certified copies of the priority documents have been received in Application No. _____.
 3. ☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

* See the attached detailed Office action for a list of the certified copies not received.

Attachment(s)

- 1) ☒ Notice of References Cited (PTO-892)
- 2) ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948)
- 3) ☐ Information Disclosure Statement(s) (PTO/SB/226)
- 4) ☐ Interview Summary (PTO-413)
- 5) ☐ Notice of Informal Patent Application
- 6) ☐ Other: _____
- Paper No(s)/Mail Date _____

DETAILED ACTION

Response to Arguments

1. Applicant's arguments filed 11/23/2009 have been fully considered but they are not persuasive.

Starting at page 9, the Applicant argues that Wilinski, Zheng and Wu do not teach computing cost values that comprise **measures of a number and extent of transitions in luminance** and/or color and /or color components for pixels of the image **on a path**, the cost values being **related to a spatial disposition of the objects** in the image, and wherein computing includes computing a cost value for a first one of the pixels by **accumulating differences between.... values of pairs of neighboring connected pixels at transitions which are disposed on a path** from the first one of the pixels to a second one of the pixels, wherein the second one of the pixels belongs to a predetermined subset of the pixels of the image and assigning a depth value corresponding to the first one of the pixels on basis of the cost value.

The Applicant first inquires how the Examiner interprets that Wilinski teaches assigning a depth value ... of depth values corresponding to the first one of the pixels by accumulating differences along a path. The question is moot, since the Examiner explicitly states that "Wilinski does not explicitly teach computing cost values that comprise respective measures of a number of and extent of transitions in luminance and/or color components for pixels of the image on a path related to a spatial disposition of objects in the image, wherein said computing includes computing a cost value for a first one of the pixels of the image by determining transitions between image segments

based on differences between luminance and/or color values of pairs of neighboring connected pixels at transitions which are disposed on a path from the first one of the pixels to a second one of the pixels wherein the second one of the pixels belongs to a predetermined subset of the pixels of the image". Why the Applicant believes that the Examiner considers this as taught by Wilinski is not clear, in view of the explicit statement by the Examiner. Wilinski however is explicitly called to teach "detecting transitions between objects in the image by contours (see p. 7, lines 29 and 30 for segmentation based on luminosity; see p. 5, lines 12-18 for using a method for detecting edges by intensity changes); and as mentioned before assigning depth to pixels in those edges, and through them to pixels in their segment". While the examiner cited Wilinski as teaching assigning depth values for a first one of the pixels, the Examiner never made the argument that it does so based on a cost value, and certainly not that it teaches the limitations within the claims related to how that cost function is calculated.

At page 10, the Applicant questions how the Examiner considers that Zheng teaches "computing a cost value for a first one of the pixels ... by accumulating differences between values of pairs of neighboring connected pixels at transitions which are disposed on a path". However, the Examiner literally states that neither Wilinski nor Zheng teach "that the measurements for depth are taken along a path which results in a cost function for each pixel which is being examined for depth". Further, the examiner notes that the Applicant has added the term "accumulating" to the claim by amendment, where the claim merely recited "determining transitions between the image segments

based on differences between luminance and/or color values of pairs of neighboring pixels". The Examiner considers moot to question the Examiner about a supposed error in the previous action concerning claim limitations that were not present in the claims, and further to inquire about the teaching of Wilinski and Zheng with respect to limitations that the Examiner has explicitly declared as not taught by either. Zheng however is explicitly considered to teach a "method to obtain shape from shading using contours (see abstract; see p. 684, 1st col., 2nd par.), where the value of the intensity difference across an edge" (and therefore between neighboring pixels) "is determined and if it is above a threshold, detects a relative depth variation between the segments (see p. 684, 2nd col., 3rd and 4th pars.)". The combination of Wilinski and Zheng is therefore considered to teach detecting the transitions between objects in the image and assigning a relative depth to each object based on these transitions, and since the differences are at the edge of an object, the transitions are detected between neighboring pixels, where the transitions are measured in terms of a difference in intensity between the pixels, and therefore luminance, and where, because the pixels used to detect edges as a transition between objects are considered to be on opposite sides of the edge if the difference between their values is above a certain threshold, the first pixel is therefore considered to be part of one object and the second pixel to another object, and necessarily belonging to two different groups of pixels of the image that are considered to belong each to a different object. The Examiner further notes that the abstract of Zheng teaches that the "new algorithm is data driven, stable, updates the **surface slope** and height maps simultaneously" (necessarily a surface slope requires

the measurement of the extent of the variation) and p. 684, col. 2, 3rd par. explicitly states "In a digital image, the pixels along the boundary could belong to either side of the boundary or their values could be composite results from **the slopes of both sides**. In our implementation, the **intensities** of the boundary pixels are determined by a local prediction **using the values of their interior neighbors**. To be more specific, the intensity of each boundary pixel is computed as $I_b = 2I_{b-1} - I_{b-2}$ where subscripts $b-1$ and $b-2$ indicate 1 and 2 **units away** from the boundary". The 2nd par. of page 684, col. 2, states that "In our algorithm we.... estimate the tangent of the curve.... And compute the intensity variances along on both sides of the curve". It is quite clear that Zheng teaches measuring both extent and transition in intensity (i.e. luminance) of pixels. The Examiner further remarks that these sections were already presented to the Applicant in the rejection.

Finally, with respect to Wu, the Applicant argues, at the end of page 10, that Wu does not teach as stated by the Examiner the reconstruction of shape information from shading through the use of paths, since Wu teaches using path-independent line integrals, apparently, since no further arguments are disclosed. The Examiner, since the applicant has underlined the term path-independent line integrals, will proceed to explain the apparent error in interpretation by the Applicant. A path-independent line integral is an integral between two points along a path in which the result of the integral is independent of the path taken. This is a fundamental theorem of Calculus, as explicitly defined by Wu, see section II., formula 2.4 and immediately surrounding text. The Examiner has included an article on line integrals that the applicant can consult

regarding both the mathematical definition of a line integral and what path-independence means (see Conservative Vector Fields and Independence of Path). The fact that the path chosen for the line integrals disclosed in Wu will not affect the outcome of the value obtained for depth of a particular pixel merely demonstrates theoretically that the method is solid, that is, that there is no need to calculate all possible paths between a pixel and another pixel in order to obtain the relative depth between them, since, apart from estimation errors, the choice of path is not relevant. Indeed Wu, explicitly teaches that why "we take multiple paths in equation 2.6 is based on that the error in depth estimation can be reduced by averaging. For the sake of simplicity, we usually choose two paths" (see par. immediately below equation 2.7). The examiner further points to equation 2.6 and 2.1 for integrating the estimated depth variations with respect to the spatial change; and formula 2.8 and immediately surrounding text for calculating the depth at a pixel in the discrete domain using the sampling spatial intervals as well as the change in depth regarding space, as well as the summation term that takes into account the number of pixel transitions between values. The examiner further notices that there is nothing particularly novel in the use of the formula 2.8, which is merely a known expansion of formula 2.6. The Examiner also further notes that the change in depth between the pixels along the path is obtained independently from the method disclosed in Wu, by a shape from shading algorithm, see section III., first par. It is inherent that the integration of discrete values requires a summation of all the discrete values, and this is basic knowledge not just in the art, but in discrete Mathematics. The Examiner further points out that the Applicant, at page 3,

lines 10-16, states, explicitly: "In an embodiment of the method according to the invention, the cost value for the first one of the pixels is computed by **accumulating the differences** between the values of the pixels, which are disposed on the path.

Accumulation, i.e. integration, summation or addition of differences is relatively easy to implement". While the Applicant seems to not see the presence of accumulation of differences as amended in the claims within Wu, it is quite clear by the Applicant's description that the integration discussed in Wu is indeed an accumulation of differences in pixel values, particularly since, as explained above, Wu teaches a line integral of these values that are obtained from shape from shading algorithms, which is shown in Zheng to be differences in intensity of the pixel values, and by definition of line integral, an accumulation of the values along a path.

Since, from the discussion above, Wilinski and Zheng teach a shape from shading algorithm that rather than obtaining the depth of all pixels is merely concerned with the depth of segments, where the depth differences are calculated between points at the edge of objects, and since Wu teaches a path method to obtain the absolute depth of pixels in an image with respect to a reference pixel, and since the depth determination disclosed in Zheng is a relative depth between the two segments delimited by the contour, the only way to determine the depth for a particular pixel belonging to such a segment is to measure that relative depth with respect to all such segments. In order to do this, the examiner considers that it would have been obvious to one of ordinary skill in the art at the time of the invention to examine the different transitions along a path from the pixel to one of the edges of the image and to sum this

differences which translate in depth differences as taught by Zheng. Therefore, it would have been obvious to one of ordinary skill in the art at the time of the invention to accumulate the differences measured as taught by Wilinski and Zheng along a path as taught by Wu, in order to obtain a global, rather than relative depth for a pixel.

At page 11, the Applicant argues against the desirability of the combination of Wilinski, Zheng and Wu, since according to the applicant the combination does not teach all the claimed features. This argument is invalid, first, because as shown above they do teach those features, and second, because whether they teach them or not has no relevance with respect to whether one of ordinary skill in the art would have found it obvious to combine whatever it is they teach for a certain purpose. At page 12, the Applicant cites a portion of the MPEP, 2143.01, now deprecated. The current section reads: "The mere fact that references can be combined or modified does not render the resultant combination obvious unless **>the results would have been predictable to one of ordinary skill in the art. KSR International Co. v. Teleflex Inc., 550 U.S. ___, ___, 82 USPQ2d 1385, 1396 (2007) ("If a person of ordinary skill can implement a predictable variation, § 103 likely bars its patentability. For the same reason, if a technique has been used to improve one device, and a person of ordinary skill in the art would recognize that it would improve similar devices in the same way, using the technique is obvious unless its actual application is beyond his or her skill." The text quoted by the Applicant represents doctrine that is in direct conflict with the decision of the Supreme Court in KSR International Co. v. Teleflex Inc.

In response to the Applicant's argument that there is no suggestion to combine the references, the examiner recognizes that obviousness can only be established by combining or modifying the teachings of the prior art to produce the claimed invention where there is some **teaching, suggestion, or motivation to do so found either in the references themselves or in the knowledge generally available** to one of ordinary skill in the art. See *In re Fine*, 837 F.2d 1071, 5 USPQ2d 1596 (Fed. Cir. 1988) and *In re Jones*, 958 F.2d 347, 21 USPQ2d 1941 (Fed. Cir. 1992). In this case, Wilinski explicitly teaches both segmenting an image and estimating the depth of the pixels by known methods, as discussed in the previous rejection; Zheng explicitly teaches shape from shading to detect relative depth between segments, and explicitly suggests previously performing image segmentation, as also discussed in the rejection, and finally Wu teaches using relative depths obtained from shape from shading in order to assign global depth to pixels in an image. Since Zheng explicitly suggests using segmentation and relative depths between segments, and since Wilinski explicitly suggests using known methods, the Examiner considers obvious to one of ordinary skill in the art to use a shape from shading method such as that taught in Zheng with the method taught in Wilinski. Further, because Wu teaches a method of obtaining absolute depth from relative depth information obtained from shape from shading, the Examiner considers that it would have been obvious to one of ordinary skill in the art at the time of the invention interested in obtaining the absolute depth of all the segments obtained by the combination of Wilinski and Zheng to use the method disclosed by Wu. Such a combination would obtain the absolute depth of the objects in the image from the path

integrals disclosed by Wu applied to the edge pixels at the transitions between objects, as discussed by Wilinski and Zheng.

The Examiner respectfully finds all of the Applicant's arguments flawed and maintains the validity of the previous rejection, modified only to accommodate the Applicant's amendments.

Claim Objections

2. Claim 6 is objected to under 37 CFR 1.75(c), as being of improper dependent form for failing to further limit the subject matter of a previous claim. Applicant is required to cancel the claim(s), or amend the claim(s) to place the claim(s) in proper dependent form, or rewrite the claim(s) in independent form.

The limitation that cost value is computed by accumulating the differences between the values of the pixels which are disposed on the path is already present in parent claim 1, by amendment.

Claim Rejections - 35 USC § 103

3. The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

(a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negated by the manner in which the invention was made.

4. Claims 1-4 and 6-13 and 15-17 are rejected under 35 U.S.C. 103(a) as being unpatentable over Wilinski et al. (WIPO Publication No. 02/095680; "Wilinski" hereinafter) in view of Zheng et al. (Q. Zheng, R. Chellappa; Estimation of Illuminant Direction, Albedo, and Shape from Shading; IEEE Transactions of Pattern Analysis and

Machine Intelligence, Vol. 13, July 1991; "Zheng" hereinafter) and Wu et al. (Z. Wu, L. Li; A Line-Integration Based Method for Depth Recovery from Surface Normals; IEEE, November 1988; "Wu", hereinafter).

Regarding claims 1, 15, 16 and 17, Wilinski teaches a method for generating from a single view input image, a depth map comprising depth values representing distances to a viewer, for respective pixels of the image (see p. 1, lines 10-18 for generating a depth map, see p. 2, lines 30-32 for a single image; see p. 8 for determining depth of pixels in the image by known methods) and assigning a depth value in a first group of depth values (and therefore a depth value of depth values) corresponding to the pixel (so that pixels belonging to the same image segment are assigned the same group of pixel values, see p. 6, lines 1 and 2 for seed values composing a pixel; see p. 8, lines 31-34 and p. 9, lines 1 and 2 for storing the depth values of the seed pixels; see p. 10, lines 26-28 for assigning to a pixel the depth value of the segment it belongs to). See p. 10, lines 21-30 for a system and units for performing the method, including an input of the digital image, and for preferably using a processor provided with a computer program to execute the method.

Wilinski does not explicitly teach computing cost values that comprise respective measures of a number of and extent of transitions in luminance and/or color components for pixels of the image on a path related to a spatial disposition of objects in the image, wherein said computing includes computing a cost value for a first one of the pixels of the image by accumulating differences between luminance and/or color values of pairs of neighboring connected pixels at transitions which are disposed on a

path from the first one of the pixels to a second one of the pixels wherein the second one of the pixels belongs to a predetermined subset of the pixels of the image. Wilinski does teach detecting transitions between objects in the image by contours (see p. 7, lines 29 and 30 for segmentation based on luminosity; see p. 5, lines 12-18 for using a method for detecting edges by intensity changes); and as mentioned before assigning depth to pixels in those edges, and through them to pixels in their segment. Zheng however teaches a method to obtain shape from shading using contours (see abstract; see p. 684, 1st col., 2nd par.), where the value of the intensity difference across an edge is determined and if it is above a threshold, detects a relative depth variation between the segments (see p. 684, 2nd col., 3rd and 4th pars.). Because Wilinski teaches performing segmentation of an image and depth determination of the pixels at the contours generated, and Zheng teaches determining the depth of edges in the image by examining intensity differences across edges, it would have been obvious to one of ordinary skill in the art at the time of the invention to combine the image segmentation and depth determination taught in Wilinski with the depth determination across edges taught by Zheng. This combination is implicitly suggested by Wilinski, which discloses segmentation and depth determination of edge pixels by known methods, and expressly by Zheng, which discloses that the method can be improved by performing segmentation first; see the last three lines of page, 684, 2nd col., 3rd par.

Neither Wilinski nor Zheng teach that the measurements for depth are taken along a path which results in a cost function for each pixel which is being examined for depth, where the cost value comprises respective measures of a number and extent of

transitions in luminance and/or color and/or color components for pixels of the image on a path related to the spatial disposition of objects of the image, wherein said computing includes computing a cost value for a first one of the pixels of the image by accumulating differences between luminance and/or color and/or color component values of pairs of neighboring connected pixels at transitions which are disposed on a path from the first one of the pixels to a second one of the pixels, wherein the second one of the pixels belongs to a predetermined subset of the pixels of the image, and assigning a depth value of depth values corresponding to the first one of the pixels on basis of the cost value. The examiner, however, considers obvious that, since the depth determination disclosed in Zheng is a relative depth between the two segments delimited by the contour, the only way to determine the depth for a particular pixel belonging to such a segment is to measure that relative depth with respect to all such segments. In order to do this, the examiner considers that it would have been obvious to one of ordinary skill in the art at the time of the invention to examine the different transitions along a path from the pixel to one of the edges of the image and to sum this differences which translate in depth differences as taught by Zheng. Reconstructing shape information from shading through the use of paths is well known in the art, as shown, for example in Wu (see abstract). Wu further teaches that why "we take multiple paths in equation 2.6 is based on that the error in depth estimation can be reduced by averaging. For the sake of simplicity, we usually choose two paths)" (see par. immediately below equation 2.7). The examiner further points to equation 2.6 and 2.1 for integrating the estimated depth variations with respect to the spatial change; and

formula 2.8 an immediately surrounding text for calculating the depth at a pixel in the discrete domain using the sampling spatial intervals as well as the change in depth regarding space, as well as the summation term that takes into account the number of pixel transitions between values. The examiner further notices that there is nothing particularly novel in the use of the formula 2.8, which is merely a known expansion of formula 2.6. The Examiner also further notes that the change in depth between the pixels along the path is obtained independently from the method disclosed in Wu, by a shape from shading algorithm, see section III., first par., and further, that the change in depth over space disclosed in Wu, since depth is obtained from shape from shading indeed constitutes a change in luminance over space, as taught by Zheng. See also p. 3, lines 10-16 in the Applicant's specification for the equivalence of accumulation and integration.

Since Wilinski explicitly teaches both segmenting an image and estimating the depth of the pixels by known methods, as discussed above; Zheng explicitly teaches shape from shading to detect relative depth between segments, and explicitly suggests previously performing image segmentation, as also discussed above, and finally Wu teaches using relative depths obtained from shape from shading in order to assign global depth to pixels in an image, and since Zheng explicitly suggests using segmentation and relative depths between segments, the Examiner considers that it would have been obvious to one of ordinary skill in the art at the time of the invention to use a shape from shading method such as that taught in Zheng as the depth generating method to be used with Wilinski. Further, because Wu teaches a method of obtaining

absolute depth from relative depth information obtained from shape from shading, the Examiner considers that it would have been obvious to one of ordinary skill in the art at the time of the invention interested in obtaining the absolute depth of all the segments obtained by the combination of Wilinski and Zheng to use the method disclosed by Wu, using the relative depth provided by the combination of Wilinski and Zheng. Such a combination would obtain the absolute depth of the objects in the image from the path integrals disclosed by Wu applied to the edge pixels at the transitions between objects, as discussed by Wilinski and Zheng.

Regarding claim 2, Wilinski, Zheng and Wu further teach implicitly that the predetermined subset comprises one selected from the group consisting of (i) pixels which are located at a border of the image, (ii) pixels of a part of the border, and (iii) a central pixel of the image". Wu however teaches setting the reference pixel at the center of the image, see p. 593, Implementation subsection, 3rd par.; where the reference point is used as the target to create paths and is given and assumed depth, see p. 592, par. below formula 2.6. The examiner considers obvious that when the image is assumed to have the object in the foreground as the central object in the image, which is a reasonable assumption for most images, the pixels at the edges of the image will more likely be the background and the pixel at the center will more likely be the foreground. Under that assumption, creating a path from the pixel being measured to the edge of the image would give a good approximation of height with respect to the background, and creating the path to the center of the image would give a good approximation to the foreground. Therefore, it would have been obvious to one of ordinary skill in the art to

use or combine such paths in order to obtain a global depth value for the pixel, when no previous knowledge of depth is available.

Regarding claim 3, Wilinski, Zheng and Wu also disclose that a first one of the differences is equal to a difference between respective values of neighboring pixels which are disposed on the path (in Zheng, as explained for claim 1, above).

Regarding claim 4, Wilinski, Zheng and Wu do not explicitly teach that a second one of the differences is equal to an absolute value of difference between respective values of neighboring pixels which are disposed on the path. Wilinski teaches that the difference is compared to a threshold; see p. 684, 2nd col., 3rd par., and a depth value is only computed if the difference is above that threshold. Obviously, when applying a threshold to the difference in intensity value, the absolute value would be used, since the difference value could be either negative or positive.

Regarding claim 6, Wilinski, Zheng and Wu do not explicitly teach that the cost value for the first one of the pixels is computed by accumulating the differences between the values of the pixels which are disposed on the path. The examiner however considers this to be obvious, as discussed for claim 1, above. See in Wu the abstract for integrating the relative depths along a path, see Applicant's own admission of integration as an equivalent to accumulation at p. 3, lines 10-16.

Regarding claim 7, Wilinski, Zheng and Wu do not explicitly teach that "the cost value for the first one of the pixels is computed by accumulating the differences between the values of the pixels which are disposed on the path", although the examiner considers this limitation obvious as discussed. Zheng further teaches that the

pixel values are adjusted to meet a predetermined threshold, see discussion for claim 4 above.

Regarding claim 8, Wilinski, Zheng and Wu do not teach that the cost value for the first one of pixels is computed by accumulating products of differences between the values of the pixels which are disposed on the path and respective weighting factors for the differences. The examiner however considers that, since Wilinski teaches that the pixels belonging to a segment receive the values for that segment, as discussed above, and the image is segmented in order to distinguish contours delimiting surfaces of the objects, and as taught by Zheng, determining the values of the edge pixels for the edge pixels requires local information, which could diffuse the value of depth for the transition at the edge where the pixel belongs (see p. 684, 2nd col., 4th par.) one of ordinary skill in the art at the time of the invention would have found it obvious to accentuate the differences between adjoining uniform surfaces by weighting the differences so that the objects silhouettes would have been more clearly defined, for example by weighting more heavily those differences that are closer to the pixel measured, thereby increasing the contrast of the resulting depth image and compensating for the possible sampling error incurred in the sampling of neighboring pixels for edge pixels.

Regarding claim 9, Wilinski, Zheng and Wu would have rendered obvious to one of ordinary skill in the art at the time of the invention that a first one of the weighting factors which is related to a difference between a value of a particular pixel and a value of its neighboring pixel, is based on a distance between the particular pixel and the first one of the pixels (see discussion for claim 8, above).

Regarding claim 10, Wilinski, Zheng and Wu would have rendered obvious to one of ordinary skill in the art at the time of the invention that a second one of the weighting factors which is related to a difference between a value of a particular pixel and a value of its neighboring pixel, is based on the location of the neighboring pixel related to the particular pixel (see discussion for claim 8, above).

Regarding claim 11, Wilinski, Zheng and Wu implicitly teach computing a second cost value for the first one of the pixels of the image by accumulating differences between luminance and/or color and/or color component values of pixels which are disposed on a second path from the first one of the pixels to a third one of the pixels which belongs to the predetermined subset of the pixels of the image (see Wu, p. 592, 1st col., par. below formula 2.7 for using multiple paths for reducing errors in measurement, see rejection for claim 1).

Although Wu teaches using the average of the relative depths obtained along the path to resolve conflicting cost values for the same pixel, the examiner considers obvious that where two or more conflicting measurements for a unique value are found, there are a limited number of choices on how to solve said conflict. Therefore it would have been obvious for one of ordinary skill in the art to modify the method disclosed in Wu, with a choice of value when two or more conflicting values are found for the same measurement to resolve this conflict by either choosing the larger value, the lower value, the average value or some weighted combination of both as also taught by Wu in the cited section. Arriving at the conclusion that the minimum value is more likely to be correct would have come naturally to one of ordinary skill in the art at the time of the

invention after normal testing of the method, if, for example, it was found that the most frequent error in measurement is to overestimate the value for a point.

Regarding claim 12, Wilinski, Zheng and Wu also teach computing a second cost value for a third one of the pixels on basis of the cost value for the first one of the pixels (in Wilinski, see p. 10, lines 26-28 for assigning each pixel the pixel value of the segment it belongs to and discussion above for calculating the depth of the pixels in the contour in order to get that depth).

Regarding claim 13, Wilinski, Zheng and Wu also teach "computing the second cost value by combining the cost value of the first one of the pixels with a difference between further values of further pixels which are disposed on a second path from the third one of the pixels to the first one of the pixels" (see discussion for claim 11, above for how Wu teaches averaging the results obtained from two paths).

5. Claim 5 is rejected under 35 U.S.C. 103(a) as being unpatentable over Wilinski et al. (WIPO Publication No. 02/095680; "Wilinski" hereinafter) in view of Zheng et al. (Q. Zheng, R. Chellappa; Estimation of Illuminant Direction, Albedo, and Shape from Shading; IEEE Transactions of Pattern Analysis and Machine Intelligence, Vol. 13, July 1991; "Zheng" hereinafter) and Wu et al. (Z. Wu, L. Li; A Line-Integration Based Method for Depth Recovery from Surface Normals; IEEE, November 1988; "Wu", hereinafter) as applied to claim 1 above, and further in view of Cahill et al. (U.S. Patent Publication No. 2004/0062439, "Cahill" hereinafter).

Regarding claim 5, Wilinski, Zheng and Wu also teach that "the values of pixels correspond to one of luminance (....)" (see discussion for claim 1, above). Wilinski,

Zheng and Wu do not teach that the values of the pixels are measured in terms of color. Cahill however also teaches a method of generating a depth map where color is used in conjunction with luminance for segmentation (see par. [0002]).

Because Wilinski, Zheng, Wu and Cahill teach methods of creating depth maps from a 2-D image, it would have been obvious to one of ordinary skill in the art at the time of the invention to modify the pixel evaluation of luminance in Wilinski, Zheng and Wu with the alternative evaluation of chrominance taught in Cahill because both techniques are interchangeable and combinable to give a more precise result, one applying to grey-level pictures, and the other to color pictures, and both are well-known in the art as taught by Cahill.

6. Claim 14 is rejected under 35 U.S.C. 103(a) as being unpatentable over Wilinski et al. (WIPO Publication No. 02/095680; "Wilinski" hereinafter) in view of Zheng et al. (Q. Zheng, R. Chellappa; Estimation of Illuminant Direction, Albedo, and Shape from Shading; IEEE Transactions of Pattern Analysis and Machine Intelligence, Vol. 13, July 1991; "Zheng" hereinafter) and Wu et al. (Z. Wu, L. Li; A Line-Integration Based Method for Depth Recovery from Surface Normals; IEEE, November 1988; "Wu", hereinafter) as applied to claim 12 above, and further in view of Nakatsuna et al. (U.S. Patent Publication No. 2002/0154116).

Regarding claim 14, Wilinski, Zheng and Wu further teach that "cost values corresponding to respective pixels of the image are successively computed on basis of further cost values being computed for further pixels" (see discussion for claim 1, above). Wilinski, Zheng and Wu do not teach that a first scan direction of successive

computations of cost values for a first row of pixels of the image is opposite to a second scan direction of successive computations of cost values for a second row of pixels of the image, although Wu teaches performing the computations on a row-by-row basis (see p. 593, subsection Implementation, first par.). Nakatsuna, however, teaches a method of interpolating depth values on a pixel-by-pixel basis (see par. [0119] and [0165]), in which the pixels are evaluated in a zigzag path, so that pixels may be positioned in a two-dimensional neighborhood (see par. [0179]).

Because Wilinski, Zheng, Wu and Nakatsuna disclose evaluating depth for pixels on a row-by-row basis, it would have been obvious to one of ordinary skill in the art at the time of the invention to combine the depth measurement method as disclosed in Wilinski, Zheng, Wu, with the zigzag inspection path disclosed in Nakatsuna. Such an approach would be representative of the well known principle of locality in program optimization, by which it is advantageous to perform tasks in such an order that the values that have just been calculated and are therefore readily available, are those needed to perform the next calculation.

Conclusion

1. Applicant's amendment necessitated the new ground(s) of rejection presented in this Office action. Accordingly, **THIS ACTION IS MADE FINAL**. See MPEP § 706.07(a). Applicant is reminded of the extension of time policy as set forth in 37 CFR 1.136(a).

A shortened statutory period for reply to this final action is set to expire THREE MONTHS from the mailing date of this action. In the event a first reply is filed within

TWO MONTHS of the mailing date of this final action and the advisory action is not mailed until after the end of the THREE-MONTH shortened statutory period, then the shortened statutory period will expire on the date the advisory action is mailed, and any extension fee pursuant to 37 CFR 1.136(a) will be calculated from the mailing date of the advisory action. In no event, however, will the statutory period for reply expire later than SIX MONTHS from the date of this final action.

Any inquiry concerning this communication or earlier communications from the examiner should be directed to Carlos Perromat whose telephone number is (571) 270-7174. The examiner can normally be reached on M-TH 8:30 am- 5:00 pm EST.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Kee M. Tung can be reached on (571)272-7794. The fax phone number for the organization where this application or proceeding is assigned is 571-273-8300.

Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see <http://pair-direct.uspto.gov>. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free). If you would like assistance from a USPTO Customer Service Representative or access to the automated information system, call 800-786-9199 (IN USA OR CANADA) or 571-272-1000.

/Kee M Tung/

/Carlos Perromat/

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Supervisory Patent Examiner, Art Unit 2628

Examiner
Art Unit 2628

C.P.